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EXAMINER	
MARTINEZ, BRITTANY M	

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1793	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/526,941	YODH ET AL.	
	Examiner	Art Unit	
	BRITTANY M. MARTINEZ	1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 March 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-139* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-139* is/are rejected.

7)☒ Claim(s) *11, 22-28, 44, 47-49, 57, 93-99 and 105* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 March 2005* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/24/2005, 12/19/2005, 6/26/2006, 12/14/2006*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Citation to the Specification will be in the following format (S. p. #, P) where # denotes the page number and P is the paragraph number. Citation to U. S. Patent literature will be in the format (Inventor, c. #, l. LL) where # is the column number and LL is the line number.

Status of Application

Claims 1-139 are pending in the instant application and have been examined.

Priority

The instant application is a national stage entry of PCT/US03/16086, filed May 21, 2003, which claims benefit of U.S. Provisional Applications No. 60/409,821, filed September 10, 2002, and No. 60/419,882, filed October 18, 2002.

Drawings

1. The drawings are objected to because Figures 1-2, 7-9, and 11-12 are not of sufficient quality for reproduction in a printed patent document. Refer to 37 CFR 1.84(b). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure

number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

2. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Objections

3. **Claims 11, 44, 57, and 105** are objected to because of the following informalities: In **Claim 11**, 2nd line, "rings" should be replaced with "ring." In **Claim 44**, 1st line, "comprise" should be replaced with "comprises." **Claim 57** is missing a period at the end of the claim. In **Claim 105**, 1st line, "a" should be placed after "comprises." In

Claims 22-28, 47-49, and 93-99, "SWNTs" should be replaced with "single-wall carbon nanotubes." Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. **Claims 16-17, 22-26, 28, 35-36, 49, 51-52, and 93-97** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

6. **Claim 16** recites the limitation "said alkaline salt" in the 1st line of the claim. There is insufficient antecedent basis for this limitation in the claim. For examination purposes, it was assumed that **Claim 16** is dependent upon **Claim 15**.

7. **Claim 17** recites the limitation "said counterion" in the 1st line of the claim. There is insufficient antecedent basis for this limitation in the claim. For examination purposes, it was assumed that **Claim 17** is dependent upon **Claim 16**.

8. **Claims 22-26, 28, 49, and 93-97** recite the limitation "single SWNTs." There is insufficient antecedent basis for this limitation in these claims.

9. **Claims 35-36** recite the limitation "the aqueous liquid phase" in the 1st line of the claims. There is insufficient antecedent basis for this limitation in these claims.

10. **Claim 51** recites the limitation "the critical micelle concentration." There is insufficient antecedent basis for this limitation in the claim.

11. **Claim 52** recites the limitation "the electronic properties." There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

12. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

13. **Claims 1-13, 15-18, 55-60, and 139** are rejected under 35 U.S.C. 102(e) as being anticipated by Smalley et al. (US 2003/0133865 A1).

14. With regard to **Claims 1-13 and 15-18**, Smalley discloses a dispersion comprising an aqueous medium; single-wall carbon nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Smalley, p. 2, 0010), substantially as in the instant application. While Smalley does not explicitly disclose a surfactant capable of non-covalently adhering to said carbon nanotubes (**Claim 3**); or the aromatic group being capable of π–like stacking onto the surface of carbon nanotubes (**Claim 9**), these claimed limitations would be inherent.

15. With regard to **Claims 55-57**, Smalley discloses a composition comprising carbon nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Smalley, p. 2, 0010; p. 7, 0060), substantially as in the instant application. Smalley further discloses that the composition may be in the form of a film (Smalley, p. 6, 0048). While Smalley does not explicitly disclose the surfactant being adsorbed to the exterior surface of said carbon nanotubes (**Claim 56**), this limitation would be inherent.

16. With regard to **Claims 58-60**, Smalley discloses a composite comprising a polymer; and carbon nanotubes and a surfactant comprising sodium dodecylbenzene sulfonate dispersed within the polymer (Smalley, p. 2, 0010 and 0014-0015; p. 7, 0060), substantially as in the instant application. Smalley further discloses that the composition may be in the form of a film (Smalley, p. 6, 0048).

17. With regard to **Claim 139**, Smalley discloses a composition comprising carbon nanotubes, gel precursor, and surfactant, said surfactant comprising sodium dodecylbenzene sulfonate (Smalley, p. 2, 0010 and 0014-0015; p. 7, 0060).

Claim Rejections - 35 USC § 103

18. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

19. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

20. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of

the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

21. **Claims 19-36 and 98-99** are rejected under 35 U.S.C. 103(a) as being unpatentable over Smalley et al. (US 2003/0133865 A1), as applied to **Claim 1** above, and further as discussed below.

22. Smalley does not explicitly disclose the concentration of dispersed carbon nanotubes being between about 0.001 mg/mL and about 500 mg/mL (**Claim 19**), at least 0.5 mg/mL (**Claim 20**), or at most 30 mg/mL (**Claim 21**); the number percentage of single SWNTs being at least 50 percent (**Claims 22, 27, and 98**), 75 percent (**Claim 23**), or 90 percent (**Claim 24**); the mean length of single SWNTs being at least about 120 nm (**Claim 25**), 300 nm (**Claim 26**), or 500 nm (**Claims 28 and 99**); the weight ratio of carbon nanotubes to surfactant being in the range from about 5 : 1 to about 1 : 10 (**Claim 29**); the carbon nanotubes being charge stabilized (**Claim 30**); the aqueous liquid phase comprising at least about 50 wt% water (**Claim 35**); or the aqueous liquid phase comprising up to about 50 wt% of a solvent different than water (**Claim 36**).

23. With regard to **Claim 30**, the claimed limitation would be inherent.

24. With regard to **Claims 19-21, 29, and 35-36**, an expected component amount or ratio is a result effective variable since one of ordinary skill in the art would expect

different properties in the product as such amount or ratio varies. Since the amount/ratio is a result effective variable, it is within the ordinary skill of one of ordinary skill in the art to develop a suitable dispersed carbon nanotube concentration, weight ratio of carbon nanotubes to surfactant, or solvent component amount. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

25. With regard to **Claims 22-24, 27, and 98**, an expected number percentage of single SWNTs is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such number percentage varies. Since the number percentage is a result effective variable, it is within the ordinary skill of one of ordinary skill in the art to develop a suitable number percentage of single SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

26. With regard to **Claims 25-26, 28, and 99**, an expected mean length of single SWNTs is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such mean length varies. Since the mean length is a result effective variable, it is within the ordinary skill of one of ordinary skill in the art to develop a suitable mean length of single SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

27. **Claims 14 and 31-34** are rejected under 35 U.S.C. 103(a) as being unpatentable over Smalley et al. (US 2003/0133865 A1) as applied to **Claim 1** above, and further in view of Wei et al. (US 6,899,947 B2).

28. Smalley does not explicitly disclose a plurality of alkyl groups being bonded to the aromatic group (**Claim 14**); said surfactant comprising at least two alkyl groups (**Claim 31**); said surfactant comprising at least two aromatic groups (**Claim 32**); said surfactant comprising at least two charged head groups (**Claim 33**); or said surfactant comprising at least two alkyl chains, at least two aromatic rings, at least two charged groups, or any combination thereof (**Claim 34**).

29. With regard to **Claims 14 and 31-34**, Wei discloses calixarene surfactants for dispersing nanoparticles (Wei, "Abstract;" c. 1, l. 48-60; c. 3, l. 38-67; c. 4, l. 1-9; Fig. 1A).

30. Thus, it would have been obvious to one of ordinary skill in the art to modify the dispersion of Smalley with the calixarene surfactants of Wei in order to obtain an inexpensive and robust dispersion (Wei, c. 3, l. 38-51).

31. **Claims 37-52** are rejected under 35 U.S.C. 103(a) as being unpatentable over Lobovsky et al. (US 2002/0113335 A1) in view of Smalley et al. (US 2003/0133865 A1).

32. With regard to **Claim 37**, Lobovsky discloses a method of preparing a dispersion of carbon nanotubes comprising mixing an aqueous medium, carbon nanotubes, and a surfactant comprising a sodium alkyl sulphate with an alkyl group having from 8 to 30 carbon atoms, such as sodium dodecyl sulphate in a low-power, high-frequency bath sonicator (Lobovsky, p. 3, 0024; p. 4, 0042; p. 5, 0050; "Example 1;" and Fig. 3).

33. With regard to **Claims 42-43**, Lobovsky discloses the bath sonicator having a power of 30 watts and a frequency of 20 kHz (Lobovsky, "Example 1").

34. Lobovsky does not explicitly disclose a surfactant comprising an aromatic group (**Claim 37**); mixing time in the bath sonicator being at least about 2 hours (**Claim 38**), 4 hours (**Claim 39**), 8 hours (**Claim 40**), or between about 16 and about 24 hours (**Claim 41**); said surfactant comprising an alkaline salt of a C_n alkyl benzene sulfonate, where n is between about 8 and about 16 (**Claim 44**); the concentration of dispersed carbon nanotubes being between about 0.001 mg/mL and about 500 mg/mL (**Claim 45**) or at least 0.5 mg/mL (**Claim 46**); the mixing time being selected to give rise to at least about 50 number percent of the dispersed carbon nanotubes being single SWNTs (**Claim 47**); the mixing time being selected to give rise to the mean length of single SWNTs being at least about 300 nm (**Claim 48**) or 500 nm (**Claim 49**); the weight ratio of carbon nanotubes to surfactant being in the range of from about 5 : 1 to about 1 : 10 (**Claim 50**); the concentration of surfactant being less than the critical micelle concentration (**Claim 51**); or electronic properties of the dispersed carbon nanotubes being essentially the same as the electronic properties of the carbon nanotubes prior to mixing (**Claim 52**).

35. With regard to **Claims 37 and 44**, Smalley discloses a dispersion comprising an aqueous medium; single-wall carbon nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Smalley, p. 2, 0010; p. 7, 0060). Thus, it would have been obvious to one of ordinary skill in the art to modify the process of Lobovsky with the sodium dodecylbenzene sulfonate of Smalley because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

36. With regard to **Claim 52**, the claimed limitation would be inherent.

37. With regard to **Claims 45-46 and 50-51**, an expected component amount or ratio is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such amount or ratio varies. Since the amount/ratio is a result effective variable, it is within the ordinary skill of one of ordinary skill in the art to develop a suitable dispersed carbon nanotube concentration, weight ratio of carbon nanotubes to surfactant, or surfactant concentration. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

38. With regard to **Claims 38-41 and 47-49**, expected mixing times, mean lengths of single SWNTs, and number percentages of single SWNTs are result effective variables since one of ordinary skill in the art would expect different properties in the product as such times, lengths, and number percentages vary. Since mixing times, mean lengths, and number percentages are result effective variables, it is within the ordinary skill of one of ordinary skill in the art to develop suitable mixing times and corresponding mean lengths and number percentages of single SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

39. **Claims 53-54** are rejected under 35 U.S.C. 103(a) as being unpatentable over Lobovsky et al. (US 2002/0113335 A1) in view of Smalley et al. (US 2003/0133865 A1) as applied to **Claim 37** above, and further in view of Yamamoto et al. (*Journal of Physics D*).

40. The aforementioned applied art does not explicitly disclose a step of electrophoretically separating the dispersed carbon nanotubes (**Claim 53**) or the carbon nanotubes being separated according to length, shape, or any combination thereof (**Claim 54**).

41. With regard to **Claims 53-54**, Yamamoto discloses electrophoretically separating dispersed carbon nanotubes according to length (Yamamoto, whole document).

42. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the prior art with the electrophoretic separation of Yamamoto because one of ordinary skill in the art could have pursued the known potential separation options within his or her technical grasp with a reasonable expectation of success.

43. **Claims 61-63, 69-70, 72, 74-101, 103-109, and 124-126** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Smalley et al. (US 2003/0133865 A1).

44. With regard to **Claims 61-63**, Glatkowski discloses a method of preparing a composite comprising dispersing carbon nanotubes and a surfactant in a hardenable matrix precursor; and hardening the precursor via curing (Glatkowski, p. 3, 0048; p. 4, 0054 and 0060-0061; p. 5, 0061; p. 6, 0082; Claims 13 and 72).

45. With regard to **Claim 63**, Glatkowski discloses thermoplastics as possible polymers used (Glatkowski, p. 3, 0048).

46. With regard to **Claim 69**, Glatkowski discloses a solid media comprising a substrate, said substrate comprising carbon nanotubes (Glatkowski, p. 1, 0015; p. 3-4,

0049; Claims 22 and 35) and a surfactant (Glatkowski, p. 4-5; 0061; Claim 72) adsorbed thereon (Glatkowski, p. 11, 0131).

47. With regard to **Claim 74**, Glatkowski discloses a method of preparing a nematic nanotube gel comprising providing a dispersion comprising carbon nanotubes, solvent, gel precursor, and a surfactant; gelling at least a portion of said gel precursor to form a gel; and subjecting the gel to an orienting field giving rise to a nematic orientation of the carbon nanotubes (Glatkowski, p. 1, 0015; p. 3, 0048-0049; p. 4, 0049, 0051, 0053-0054, 0057-0058, and 0060-0061; p. 5, 0061; p. 6, 0082; Claims 13 and 72).

48. With regard to **Claim 75**, Glatkowski discloses an orienting field comprising a pressure field (Glatkowski, p. 4, 0057).

49. With regard to **Claim 76**, Glatkowski discloses the carbon nanotubes being single-wall or multi-wall carbon nanotubes (Glatkowski, Claim 63).

50. With regard to **Claim 105**, Glatkowski discloses the gel precursor comprising polymers or monomers (Glatkowski, p. 3, 0048).

51. With regard to **Claims 106-108**, Glatkowski discloses a styrenic monomer (Glatkowski, p. 3, 0048).

52. With regard to **Claim 109**, Glatkowski discloses the polymer gel precursor further comprising a crosslinker (Glatkowski, p. 4, 0060).

53. With regard to **Claim 124**, Glatkowski discloses the step of micro-phase separating the dispersion into nanotube rich/gel poor and nanotube poor/gel rich phases (Glatkowski, p. 4, 0054).

54. With regard to **Claim 125**, Glatkowski discloses the gel being a polymer gel (Glatkowski, p. 3, 0048; p. 4, 0051).

55. With regard to **Claim 126**, Glatkowski discloses the field being a pressure field giving rise to transport of at least a portion of the solvent out of the gel (Glatkowski, p. 4, 0049 and 0057).

56. Glatkowski does not explicitly disclose said surfactant comprising an alkyl group having from about 4 to about 30 carbon atoms (**Claims 61 and 74**), about 6 to about 30 carbon atoms (**Claim 69**), or about 10 and about 14 carbon atoms (**Claim 78**), an aromatic group, and a head group (**Claims 61, 69, and 74**); curing the precursor with light, heat, radiation, or time (**Claim 62**); the hardenable matrix precursor being a polymer capable of solidifying upon cooling to a temperature being lower than its glass transition temperature, its crystalline melt transition, its order-disorder transition temperature, or any combination thereof (**Claim 63**); the substrate capable of receiving chemical, biological, or both chemical and biological compounds for detection (**Claim 69**); the surfactant being adsorbed to the exterior surface of the carbon nanotubes (**Claim 70**); the carbon nanotubes being capable of adsorbing protons to give rise to a detectable signal (**Claim 72**); the surfactant being adsorbed to the carbon nanotubes (**Claim 77**); the aromatic group being disposed between the alkyl group and the charged head group (**Claim 79**); the aromatic group being capable of π–like stacking onto the surface of carbon nanotubes (**Claim 80**); the aromatic group comprising at least one carbocyclic aromatic ring, heterocyclic aromatic ring, or any combination thereof (**Claim 81**); said aromatic group comprising at least one benzene ring (**Claim**

82); said charged head group comprising a sulfate group, sulfonate group, amine group, ammonium group, or any combination thereof (**Claim 83**); said surfactant comprising said alkyl group bonded to the aromatic group, said aromatic group being further bonded to the head group (**Claim 84**); said alkyl group having between about 8 and about 16 carbon atoms, and said charged head group comprising sulfonate (**Claim 85**); said surfactant comprising an alkaline salt of a C_n alkyl benzene sulfonate, where n is between about 8 and about 16 (**Claim 86**); said alkaline salt comprising at least one counterion selected from the Group IA elements (**Claim 87**); said counterion being sodium, potassium, or any combination thereof (**Claim 88**); said surfactant comprising sodium hexylbenzene sulfonate, sodium octylbenzene sulfonate, sodium dodecylbenzene sulfonate, sodium hexadecylbenzene sulfonate, or any combination thereof (**Claim 89**); the concentration of dispersed carbon nanotubes being between about 0.001 mg/mL and about 500 mg/mL (**Claim 90**), at least 0.5 mg/mL (**Claim 91**), or at most 30 mg/mL (**Claim 92**); the number percentage of single SWNTs being at least 50 percent (**Claim 93**), 75 percent (**Claim 94**), or 90 percent (**Claim 95**); the mean length of single SWNTs being at least about 120 nm (**Claim 96**) or 300 nm (**Claim 97**); the weight ratio of carbon nanotubes to surfactant being in the range from about 5 : 1 to about 1 : 10 (**Claim 100**); the carbon nanotubes being charge stabilized (**Claim 101**); the solvent comprising at least about 50 wt% water (**Claim 103**); the solvent comprising up to about 50 wt% of a solvent different than water (**Claim 104**); or the micro-phase separating step being carried out under conditions giving rise to polymerization-induced phase separation (**Claim 125**).

57. With regard to **Claims 61 and 69**, Smalley discloses a dispersion comprising carbon nanotubes and a surfactant comprising sodium dodecylbenzene sulfonate (Smalley, p. 2, 0010; p. 7, 0060). With regard to **Claim 69**, Smalley discloses carbon nanotube composite materials useful as chemical sensors (Smalley, p. 6, 0048). Thus, it would have been obvious to one of ordinary skill in the art to modify the product and process of Glatkowski with the sodium dodecylbenzene sulfonate of Smalley because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

58. With regard to **Claim 62**, light, heat, radiation, and time are all well-known curing approaches in the art.

59. With regard to **Claim 63**, it is well-known in the art that thermoplastics solidify upon cooling to a temperature lower than the specific plastic's glass transition temperature.

60. With regard to **Claim 70**, while the aforementioned applied art does not explicitly disclose the surfactant being adsorbed to the exterior surface of said carbon nanotubes, it is well-known in the art that surfactants adsorb to the exterior surface of carbon nanotubes.

61. With regard to **Claim 72**, while the aforementioned applied art does not explicitly disclose the carbon nanotubes being capable of adsorbing protons to give rise to a detectable signal, it is well-known in the art that carbon nanotubes are capable of adsorbing protons and thus give rise to detectable signals.

62. With regard to **Claims 74, 77-79, 81-89**, Smalley discloses a dispersion comprising an aqueous medium, single-wall carbon nanotubes and a surfactant comprising sodium dodecylbenzene sulfonate adsorbed to the carbon nanotubes (Smalley, p. 2, 0010; p. 7, 0060). Thus, it would have been obvious to one of ordinary skill in the art to modify the product of Glatkowski with the sodium dodecylbenzene sulfonate of Smalley because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

63. With regard to **Claim 80**, although Glatkowski does not explicitly disclose the aromatic group being capable of π–like stacking onto the surface of carbon nanotubes, this claimed limitation would be inherent.

64. With regard to **Claim 101**, the claimed limitation would be inherent.

65. With regard to **Claims 90-92, 100, and 103-104**, an expected component amount or ratio is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such amount or ratio varies. Since the amount/ratio is a result effective variable, it is within the ordinary skill of one of ordinary skill in the art to develop a suitable dispersed carbon nanotube concentration, weight ratio of carbon nanotubes to surfactant, or solvent component amount. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

66. With regard to **Claims 93-95**, an expected number percentage of single SWNTs is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such number percentage varies. Since the number

percentage is a result effective variable, it is within the ordinary skill of one of ordinary skill in the art to develop a suitable number percentage of single SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

67. With regard to **Claims 96-97,** an expected mean length of single SWNTs is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such mean length varies. Since the mean length is a result effective variable, it is within the ordinary skill of one of ordinary skill in the art to develop a suitable mean length of single SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

68. With regard to **Claim 125**, it would have been obvious to one of ordinary skill in the art that in order to carry out the micro-phase separating step, the step would need to be carried out under conditions giving rise to polymerization-induced phase separation.

69. **Claims 64-68** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Smalley et al. (US 2003/0133865 A1) and Wei et al. (US 6,899,947 B2).

70. With regard to **Claim 64**, Glatkowski discloses an assembly comprising a substrate; and carbon nanotubes (Glatkowski, p. 1, 0015; p. 3-4, 0049; Claims 22 and 35) and a surfactant (Glatkowski, p. 4-5; 0061; Claim 72) adjacent to said substrate (Glatkowski, p. 11, 0131).

71. With regard to **Claim 67**, Glatkowski discloses a method of assembling carbon nanotubes comprising contacting a dispersion comprising an aqueous medium, carbon

nanotubes and a surfactant (Glatkowski, p. 1, 0015; p. 3-4, 0049; p. 4-5; 0061; p. 11, 0131; Claims 22, 35, and 72).

72. Glatkowski does not explicitly disclose said surfactant comprising an alkyl group having from about 4 to about 30 carbon atoms, an aromatic group, and a head group (**Claims 64 and 67**); the carbon nanotubes being self-assembled on the substrate (**Claims 65 and 68**); or the surfactant being adsorbed to the exterior surface of the carbon nanotubes (**Claim 66**).

73. With regard to **Claim 64**, Smalley discloses a dispersion comprising carbon nanotubes and a surfactant comprising sodium dodecylbenzene sulfonate (Smalley, p. 2, 0010; p. 7, 0060). With regard to **Claim 67**, Smalley discloses a dispersion comprising an aqueous medium, carbon nanotubes and a surfactant comprising sodium dodecylbenzene sulfonate (Smalley, p. 2, 0010; p. 7, 0060). Thus, it would have been obvious to one of ordinary skill in the art to modify the product and process of Glatkowski with the sodium dodecylbenzene sulfonate of Smalley because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

74. With regard to **Claims 65 and 68**, Wei discloses self-assembly of nanoparticles as one of the key methodologies in materials synthesis (Wei, c. 1, l. 16-29; Claim 4). Thus, it would have been obvious to one of ordinary skill in the art to modify the product and process of the aforementioned applied art with the self-assembly of Wei in order to obtain a process capable of producing a product with possible use in optical/infrared scattering, radiation shielding, or sensing (Wei, c. 1, l. 16-29).

75. With regard to **Claim 66**, while the aforementioned applied art does not explicitly disclose the surfactant being adsorbed to the exterior surface of said carbon nanotubes, it is well-known in the art that surfactants adsorb to the exterior surface of carbon nanotubes.

76. **Claims 71 and 102** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Smalley et al. (US 2003/0133865 A1) as applied to **Claims 69 and 74** above, and further in view of Wei et al. (US 6,899,947 B2).

77. The aforementioned applied art does not explicitly disclose the carbon nanotubes being self-assembled on the substrate (**Claim 71**); or said surfactant comprising at least two alkyl chain tails (**Claim 102**).

78. With regard to **Claim 71**, Wei discloses self-assembly of nanoparticles as one of the key methodologies in materials synthesis (Wei, c. 1, l. 16-29; Claim 4). Thus, it would have been obvious to one of ordinary skill in the art to modify the product of the aforementioned applied art with the self-assembly of Wei in order to obtain a process capable of producing a product with possible use in optical/infrared scattering, radiation shielding, or sensing (Wei, c. 1, l. 16-29).

79. With regard to **Claim 102**, Wei discloses calixarene surfactants for dispersing nanoparticles (Wei, "Abstract;" c. 1, l. 48-60; c. 3, l. 38-67; c. 4, l. 1-9; Fig. 1A).

80. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the calixarene surfactants of Wei in order to obtain a process utilizing an inexpensive and robust dispersion (Wei, c. 3, l. 38-51).

81. **Claim 73** is rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Smalley et al. (US 2003/0133865 A1) as applied to **Claim 69** above, and further in view of Cho et al. (US 7,013,708 B1).

82. The aforementioned applied art does not explicitly disclose the carbon nanotubes being chemically functionalized to adsorb specific biological or chemical substances to give rise to a detectable signal (**Claim 73**).

83. With regard to **Claim 73**, Cho discloses chemically functionalizing carbon nanotubes to adsorb specific biological or chemical substances to give rise to a detectable signal (Cho, c. 1, l. 22-32; c. 3, l. 38-45; c. 7, l. 30-33; and c. 8, l. 31-37). Thus, it would have been obvious to one of ordinary skill in the art to modify the product of the aforementioned applied art with the functionalized carbon nanotubes of Cho because one of ordinary skill in the art could have pursued the known potential sensing options within his or her technical grasp with a reasonable expectation of success.

84. **Claims 110-111** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Smalley et al. (US 2003/0133865 A1) as applied to **Claim 105** above, and further in view of Pienkowski et al. (US 2002/0001620 A1).

85. The aforementioned applied art does not explicitly disclose an initiator (**Claim 110**) or an accelerator (**Claim 111**).

86. With regard to **Claims 110-111**, Pienkowski discloses a method of producing a resin comprising carbon nanotubes dispersed in a polymethylmethacrylate matrix, wherein the polymer gel precursor further comprises an initiator and an accelerator (Pienkowski, 0006; 0019).

87. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the initiator and accelerator of Pienkowski because one of ordinary skill in the art could have pursued the known potential options for maximizing process efficiency within his or her technical grasp with a reasonable expectation of success.

88. **Claims 112-122** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Smalley et al. (US 2003/0133865 A1) as applied to **Clam 75** above, and further in view of Ilmain (*Nature*).

89. With regard to **Claim 120**, Smalley discloses removing the solvent from the gel after heating the gel (Smalley, p. 6, 0049; 0089).

90. The aforementioned applied art does not explicitly disclose a thermodynamic field giving rise to a volumetric phase transition (**Claim 112**); the volumetric phase transition arising from a change in temperature (**Claim 113**), an increase in temperature (**Claim 114**), or an incompatibility between the gel and the solvent (**Claim 115**); the incompatibility between the gel and the solvent arising from a decrease in a specific

attractive interaction (**Claim 116**), wherein the specific attractive interaction is hydrogen bonding (**Claim 117**); the gel being a polymer gel comprising a network, and the volumetric phase transition arising upon increasing temperature, wherein the polymer network becomes hydrophobic and the solvent is expelled from the gel (**Claim 118**); the solvent comprising at least about 50 weight percent water (**Claim 119**); the ratio of the volume of the gel before the volumetric phase transition to the volume of the gel after the volumetric phase transition being in the range of from about 1.1 : I to about 50 : 1 (**Claim 121**); or the ratio being in the range of from about 4:1 to about 30:1 (**Claim 122**).

91. With regard to **Claims 112-114**, Ilmain discloses thermodynamic fields giving rise to volumetric phase transitions in gels, the volumetric phase transitions arising from an increase in temperature (Ilmain, Abstract).

92. With regard to **Claims 115-117**, Ilmain discloses a volumetric phase transition arising from an incompatibility between a gel and a solvent, wherein the incompatibility between the gel and the solvent arises from a decrease in hydrogen bonding (Ilmain, p. 401).

93. With regard to **Claim 118**, Ilmain discloses a gel being a polymer gel comprising a network, and a volumetric phase transition arising upon increasing temperature, wherein the polymer network becomes hydrophobic and the solvent is expelled from the gel (Ilmain, p. 400-401).

94. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the volumetric phase transitions of Ilmain

because one of ordinary skill in the art could have pursued the known potential options for gel manipulation within his or her technical grasp with a reasonable expectation of success.

95. With regard to **Claim 119**, an expected component amount is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such amount varies. Since the amount is a result effective variable, it is within the ordinary skill of one of ordinary skill in the art to develop a suitable solvent component amount. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

96. With regard to **Claims 121-122**, an expected volume ratio associated with a volumetric phase transition is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such ratio varies. Since the volume ratio is a result effective variable, it is within the ordinary skill of one of ordinary skill in the art to develop a suitable ratio of the volume of the gel before the volumetric phase transition to the volume of the gel after the volumetric phase transition. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

97. **Claim 123** is rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Smalley et al. (US 2003/0133865 A1) as applied to **Claim 74** above, and further in view of de Heer et al. (*Science*).

98. The aforementioned applied art does not explicitly disclose the gel becoming birefringent subsequent to subjecting said gel to the orienting field (**Claim 123**).

99. With regard to **Claim 123**, de Heer discloses an aligned carbon nanotube film becoming birefringent subsequent to subjecting said film to an orienting field (de Heer, p. 845-846).

100. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the birefringence of de Heer in order to obtain a process capable of producing a nanotube gel with possible applications in various optical technologies.

101. **Claims 127-133** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Smalley et al. (US 2003/0133865 A1) as applied to **Claim 126** above, and further in view of Shambaugh (US 7,001,556 B1).

102. The aforementioned applied art does not explicitly disclose the gel being confined to a restricted geometry vessel (**Claim 127**); the gel being confined to a capillary tube during transport of at least a portion of the solvent out of the gel (**Claim 128**); the gel being confined to a capillary tube after transport of at least a portion of the solvent out of the gel (**Claim 129**); the gel being confined to a capillary tube both during and after transport of at least a portion of the solvent out of the gel (**Claim 130**); the gel being confined to a capillary tube (**Claim 131**); the pressure field being lower than the partial pressure of the solvent in the vapor phase (**Claim 132**); or the pressure field being an applied vacuum (**Claim 133**).

103. With regard to **Claims 127-133**, Shambaugh discloses a method for producing carbon nanotube/matrix composite materials with anisotropic structure, wherein a

composite mixture is passes through a capillary and shear attenuation pressure is applied to the composite, either as the composite passes through the capillary, and/or after the composite passes through the capillary (Shambaugh, c. 2, l. 43-67). Shambaugh further discloses solvent material being removed from the nanotube/solvent/matrix mixture to form a nanotube/matrix composite via atmospheric pressure and/or reduced pressure (vacuum) in a manner well-known in the art (Shambaugh, c. 5, l. 45-57).

104. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the capillary tube of Shambaugh because one of ordinary skill in the art could have pursued the known potential options for nanotube orientation within a gel via pressure within his or her technical grasp with a reasonable expectation of success.

105. **Claims 134-136** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Smalley et al. (US 2003/0133865 A1) as applied to **Claim 75** above, and further in view of Smith et al. (*Applied Physics Letters*).

106. The aforementioned applied art does not explicitly disclose the field being a magnetic field having a strength between about 0.01 Tesla and about 60 Tesla (**Claim 134**); the viscosity of the gel while the dispersion is being subjected to the magnetic field being in the range of from about 1 centipoise to about 5000 centipoise (**Claim 135**); or the concentration of the carbon nanotubes being in the range of from about 0.01 mg/ml to about 500 mg/ml (**Claim 136**).

107. With regard to **Claim 134**, Smith discloses carbon nanotube alignment in films using a 25 Tesla strong magnetic field (Smith, p. 663).

108. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the magnetic field of Smith because one of ordinary skill in the art could have pursued the known potential options for nanotube orientation within his or her technical grasp with a reasonable expectation of success.

109. With regard to **Claim 135**, an expected viscosity is a result effective variable since one of ordinary skill in the art would expect different properties in the gel as such property varies. Since the viscosity is a result effective variable, it is within the ordinary skill of one of ordinary skill in the art to develop a suitable gel viscosity. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

110. With regard to **Claim 136**, an expected component concentration is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such concentration varies. Since the component concentration is a result effective variable, it is within the ordinary skill of one of ordinary skill in the art to develop a suitable carbon nanotube concentration. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

111. **Claims 137-138** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Smalley et al. (US 2003/0133865 A1) as applied to **Claim 74** above, and further in view of Barrera et al. (WO 01/92381 A1).

112. With regard to **Claim 138**, Glatkowski discloses the step of removing solvent from the gel (Glatkowski, p. 3-4, 0049).

113. The aforementioned applied art does not explicitly disclose at least a portion of the carbon nanotubes aligned end-on-end giving rise to a carbon nanotube needle (**Claim 137**).

114. With regard to **Claim 137**, Barrera discloses end-to-end nanotube contact being necessary for conduction in carbon nanotube gels (Barrera, p. 14, l. 18-22).

115. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the end-to-end alignment of Barrera in order to obtain a carbon nanotube gel capable of conductance.

Conclusion

1. No claim is allowed.

2. In general, prior art renders the claimed invention anticipated and obvious.

3. Applicant is required to provide pinpoint citation to the specification (i.e. page and paragraph number) to support any amendments to the claims in all subsequent communication with the examiner. **No new matter will be allowed.**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRITTANY M. MARTINEZ whose telephone number is (571) 270-3586. The examiner can normally be reached Monday-Friday 9:00AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached at (571) 272-1358. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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